AG-FO-0725 — 1985

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MAGNESIUM for minnesota soils

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Although magnesium (Mg) is an essential element for plant growth, its use in a fertilizer program receives only minor emphasis. For most of Minnesota, this lack of emphasis is justifiable. The majority of soils in western Minnesota have high levels of Mg naturally. For the acid soils of eastern Minnesota, adding dolomitic limestone should supply adequate Mg for crop growth. If Mg is limited in the diet, animals can develop grass tetany. Therefore, some emphasis is given to the Mg status of forage crops in Minnesota.

The Role of Magnesium in the Plant

Magnesium is the central core of the chlorophyll molecule in plant tissue. So, if Mg is deficient, there is a shortage of chlorophyll, which results in poor plant growth.

Magnesium also helps to activate specific enzyme systems. Enzymes are complex substances that change or break down large compounds into simple products that can be used by plants. Enzymes are also important in the production of some compounds in plants.

Magnesium is mobile in plants. It usually moves from older to younger tissue.

Magnesium in the Soil

In Minnesota, magnesium deficiency has only been observed on very acid soils. In addition, these soils usually have a sandy loam, loamy sand, or sand texture. A magnesium deficiency is not likely to occur until the soil pH drops below 5.5. In Minnesota, acid sandy soils occur in the eastern one-third of the state.

Magnesium deficiency should be of concern where potatoes are grown on acid sandy soils or where corn follows a potato crop. Sometimes grass tetany problems have been reported where high rates of potash have been used on grass pastures. Research trials, however, have shown that the use of Mg in a fertilizer program on these pastures has not increased forage yields. For these situations, it is less expensive to supplement the diet of the animal with a salt containing Mg.

There is a standard soil test that can be used to determine the status of Mg in soils. This test is suggested for *sandy* soils only. If there is some

Figure 1. Magnesium deficiency in field corn. Notice that white strips occur over the entire length of the leaf.

doubt, the results of the soil test will provide an accurate assessment of the Mg status of a field.

Deficiency Symptoms and Plant Analysis

The loss of a healthy green color can be the first indication of a Mg deficiency. Color loss reflects the shortage of chlorophyll in the plant. As the deficiency becomes more severe, the area between the veins in the leaves becomes yellow while the veins stay green. In corn, there is a definite striping the full length of the leaf, appearing first on the lower leaves (see Figure 1.)

In potatoes, the loss of green color begins on the tips of the lower leaves when there is a mild deficiency. When the deficiency is more serious, the yellowing progresses between the veins toward the center of the leaf. In the advanced stages of deficiency, leaf areas between the veins show small brown dead spots. Eventually the entire leaf is affected. The lower leaves roll upward and become brittle with bulging between the veins (see Figure 2). The leaves die prematurely and drop off, and the entire plant appears to be severely stunted. Diseases, herbicide damage, and environmental factors also cause leaves to die prematurely. So care should be taken in identifying a Mg deficiency. Use plant analysis to be sure.

Figure 2. Magnesium deficiency in potatoes. Lower leaves show symptoms first.

Table 1. Relative Mg levels of selected tissue of several crops.*

Crop	Plant part	Time of sampling	Mg status			
			Deficient	Low	Sufficient	High
			— — — — % Mg — — — —			
Corn	Ear leaf	Silking	<.10	.10-.15	.16-.40	> .40
Soybeans	Top fully developed trifoliate leaves	Pod set	<.10	.11-.25	.26-1.0	>1.0
Oats	Upper leaves	Boot	— —	.13	.13-.40	> .40
Potatoes	Petiole	Bloom	<.20	.20-.30	.30-.70	> .70
Alfalfa	Upper one-third	One-tenth bloom	<.20	.20-.30	.31-1.0	>1.0

*Adapted from *Soil Testing and Plant Analysis.* SSSA. 1973.

Plant analysis can be used to assess the status of Mg in major crops. The critical levels for major crops in Minnesota are given in Table 1.

The Need for Magnesium in a Fertilizer Program

As mentioned previously, there is not a widespread need for the addition of Mg in fertilizer programs in Minnesota. The potential for a need for Mg is highest where sandy soils are very acid. Several soil testing laboratories will analyze soil samples for Mg. In areas where soil pH is above 6 and dolomitic lime has been used, soil testing for Mg is unnecessary. Recommendations of Mg for potato production are listed in Table 2; suggestions for corn are summarized in Table 3.

For most crops, the use of dolomitic limestone is the best and most economical method of applying Mg. Lime, however, is generally not used routinely in potato production. Other sources of Mg are available for these situations.

The double salt of potassium and magnesium sulfate sold as Sul-Po-Mag or K-Mag contains 11 percent Mg. This material can be either applied directly or blended with N-P-K fertilizer and broadcast or applied in the row at planting. Epsom salts (magnesium sulfate) can also be used to supply

Table 2. Magnesium recommendations for potato production.

Magnesium soil test*		Relative	Mg to apply	
Mineral soil	Organic soil	level	Row	Broadcast
— — — — lb./acre — — — —			— — lb./acre — —	
0-50	0-100	Low	20-30	100-150
51-100	101-200	Medium	10-20	50-100
100+	200+	High	0	0

*Some labs report soil test values in ppm (ppm × 2 = lb./acre).

Table 3. Magnesium recommendations for corn production on sandy soils.

	Relative	Mg to apply	
Magnesium soil test	level	Row	Broadcast
— — — lb./acre — — —		— — lb./acre — —	
0-100	Low	10-20	50-100
101-300	Medium*	Trial	Trial
300+	Adequate	0	0

*Apply 10-20 pounds of Mg/acre in a starter only if a Mg deficiency is suspected or if a deficiency of Mg has been confirmed by plant analysis.

Mg. This material, however, may not be readily available and the cost will probably be prohibitive.

Relationship of Mg to K and Ca in Soils

Approximately 30 years ago, there were some surveys conducted in the eastern United States that indicated there was an ideal balance between potassium (K) and Mg as well as calcium (Ca) and Mg in soils. This old information has been used by some individuals and soil testing laboratories to adjust fertilizer recommendations for both K and Mg.

More recent research in several states has shown that there is no ideal balance among these three nutrients. In Wisconsin, a variation in the ratio of Ca to Mg from 2 to 8 did not have any measurable effect on the yield of either alfalfa or corn.

Applications of excessive amounts of K will reduce the uptake of Mg in some crops. The rates of fertilizer K needed to reduce Mg uptake, however, are very high and the cost would be prohibitive. Excessive applications of Mg have had no effect on K uptake by plants. Therefore, as fertilizer recommendations are developed for crop production, emphasis should be placed on providing adequate amounts in soils rather than on maintaining certain ratios of one nutrient to the other in soils.

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